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INSTITUTIONAL ARRANGEMENTS IN CATTLE-RAISING ACTIVITIES IN THE 19TH CENTURY AMERICAN WEST AND THEIR EXPLANATION

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Most analysts of the creation and evolution of property rights over any productive factor, such as land, capital or labor, stress the relevance of the scarcity value of the factor relative to the costs of excluding others from its use. In the context of property rights over land that implies that property rights in general and private property rights in particular should develop when the value of land is high relative to exclusion costs.

The 19th Century American West provides something of an anomaly inasmuch as, despite the fact that land values rose and exclusion costs fell, especially after the development of cheap but effective barbed wire fences, in effect the property rights remained those of the common property form rather than individual private property. The dominant explanation for this anomaly is the existence of artificial re~tr~ctions on the maximum size of private landholdings associated with the various homestead acts. The present paper points out that there were in fact numerous ways of getting around these legal restrictions casting doubt on the validity of this explanation.

Instead, it develops an alternative explanation for the prevalence of common property arrangements in the American West even after land values rose and exclusion costs fell in the late 19th Century. The alternative explanation features the relevance of economies of scale in the relevant economic activities, namely, cattle raising in arid and semi-arid conditions of the non-irrigated lands which dominated the region at that time. In such circumstances, the value of land - irrespective of ownership- rises with the effective size of the managed holding.

The paper documents the magnitude of these scale economies in a number of different respects such as risk pooling and reduction, policing, marketing and disease and predator control. While economies of scale are already acknowledged and appreciated in several of these respects, that with respect to risk reduction - probably the most important and most generally applicable of these respects- is much underappreciated. Lying behind this form of scale economies is the local variability or rainfall, a basic characteristic of arid and semi-arid areas including much of the American West.

The paper then goes on to provide various kinds of evidence to support the alternative explanation over the existing - legal restrictions- one. One type of evidence is that the alternative is more consistent with the details of the then prevailing pooling arrangements. Another is that it is more consistent with the timing of both the rise and eventual fall of these arrangements than the legal restrictions explanation. Still another is that only the alternative explanation can be applied to those rather numerous and important cases where the legal

constraints were not operative as for example in the former dependencies of Spain and Mexico, such as California, Texas and New Mexico, where huge private landholdings existed well before statehood but nevertheless where almost invariably the private landowners would still pool their already large landholdings so as to form even larger and more gigantic ones. Finally, it is shown to be consistent with geographic variation in the relative importance of such land-pooling arrangements across different parts of the American West in that the pooling arrangements were more prominent and lasted longer in those states such as Wyoming and Texas where the local variability of rainfall is greater than in other states of the American West such a~ Iowa

Institutional Arrangements in Cattle-Raising Activities in the 19th Century American West and their Explanation*

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ABSTRACT

The dominant explanation for the various land pooling arrangements that existed in the 19th Century American West is that private property in land for purposes of cattle raising was rendered infeasible by the artificial restrictions on the creation of private property rights. This paper develops an alternative explanation based on the suitability of such arrangements to the various other environmental conditions then prevailing in the region. It demonstrates that the alternative explanation is more consistent with the details of such arrangements, the timing of their eventual decline and their spatial distribution than the existing one.

Among resource and property rights economists, there has been increasing acceptance of the view that common property rights can be as efficient as private property rights under certain circumstances.[1] The key to such a position is the realization that common property rights need not imply open access and the tragedy of the commons with which such rights have often been associated. Among economic historians of the American West, however, there remains the view that the common property rights which were so pervasive in this region during the 19th Century were inefficient and attributable only to legal and other obstacles to the practice of private property rights.[2]

The purpose of this paper is to question the empirical basis for this conclusion and to offer the alternative hypothesis that the property and other arrangements adopted by Western ranchers were chosen because they suited well the technological and other environmental conditions prevailing in the region at that time, regardless of whether or not the legal and other constraints were operative. The paper demonstrates that the alternative hypothesis provides a better explanation for each of the following: (1) the details of such arrangements, including why there was private property in animals but common property in land, (2) the timing of their downfall and the transition to private ownership and leasing of land, (3) interstate variation in the relative strength and duration of the common property arrangements, and (4) the existence of land pooling arrangements even when and where there were no artificial restrictions on the size or price of private landholdings. Since other regions of the world still share many of the environmental characteristics of the

19th Century American West, the implications are not necessarily confined to this period and region.

The conventional explanation for the limited role of private land in the 19th Century American West hinges on the facts that (1) as a result of conquest and purchase, most of the land in the region was originally in government hands, and (2) legal constraints --in the form of artificially high (regulated) prices on sales of such land or alternatively size limitations on plots--[3] impeded the transmission of land from government into private hands, thereby forcing settlers to the region to claim common property rights to land as a second-best solution. Even when these constraints were partially relaxed, as in the Desert Land Act of 1877, the Enlarged Homestead Act of 1909 and the Stock Raising Homestead Act of 1916, in the arid and semi-arid conditions of the American West in which farm and ranches had to be very large to be economically viable, these constraints were of sufficient importance to prevent private farms and ranches of sufficient size from being legally formed. Only by jointly claiming large tracts of public land and enforcing their claims by mutual defence could the land be put into production.

Yet, regardless of the official prices or acreage limitations, large tracts of land were in fact acquired by settlers and sometimes corporations.[4] Indeed, the literature on the subject indicates that less than thirty percent of the federal lands were disposed of through homestead claims (Davis, et al., 1972, p. 108), much of the rest being disposed of in large blocks, such as railroad grants and grants to states.

Although not generally realized, as pointed out below much of the vast territories of Texas and California which were annexed by the United States in the Mexican War were already in large private estates as a result of previous grants to private individuals by the governments of Spain, Mexico and Texas.[5] Hence, we lack a convincing explanation as to why settlers who owned their land in fee simple chose to raise cattle in lands that were used in common.[6]

What follows is an economic explanation for the pooling of land resources in arid environments and the retention of private property in animals.[7] We make use of two central ideas: the importance of economies of scale in animal husbandry and the need to improve the quality of cattle herds by means of greater control and supervision of the animals. While it is our assertion that these considerations were of relevance and importance in the 19th Century American West, it is not our intention to deny the relevance of other considerations already emphasized in the literature. Rather, our intent is to enrich the complexity of the decision making process by calling attention to heretofore neglected factors, such as the effect of weather variability. Unlike much of the existing literature, however, which explains common property arrangements exclusively in terms of risk-reduction (e.g., McCloskey, 1975) on the one hand, or transaction costs (e.g. Dahlman, 1980) on the other, our analysis emphasizes the complementarity between the two approaches.

Environmental Conditions and Their Implications.

The 19th century American West was characterized by (1) abundant grasslands that could be easily used for animal grazing, (2) the absence of cheap fencing materials, (3) poor transportation networks,

(4) the lack of reliable water sources, (5) minimal enforcement of law and order, and (6) low population density.[8] It is not surprising, then, that animal husbandry rather than agriculture became the main commercial activity for early settlers.

As explained momentarily, all that was required for adequate care of the animals was to find appropriate pastures and water. In the absence of fences, the animals could find or be led to areas where both pasture and water were available, and they could literally walk to the market or to shipment points (Dary, 1981). In the absence of state-provided security, by their mobility the animals could be better protected from raiders than immobile crops.[9] Low population densities both made land values cheap and allowed the animals to roam without disrupting other economic activities.

What limited the labor requirements of the industry was the hardiness of the cattle, primarily the Texan Longhorns (and related mixed breeds)[10] which came to dominate much of the American West (Dale, 1960, p. 150). These cattle could reproduce and take care of themselves with minimal supervision. As long as they were free to move,[11] the Longhorns could survive both harsh winters and storms and hot, dry summers on the open range by finding water sources on their own and by defending themselves against other animal predators.[12]

What the animals could not do on their own was to be self-selecting in their breeding behavior; hence any intermingling of cattle would undermine efforts to raise beef quality, an important consideration since Longhorns yielded less meat than higher-valued but less hardy breeds.[13] The adverse effect of intermingling on

herd quality could be felt also over the short run due to the effect of intermingling on the spread of contagious diseases.[14] In addition, the pooling of resources may lead to overgrazing and pasture degradation, especially in the case of open access.[15] However, even under normal conditions, animal husbandry is known to exhibit economies of scale in animal supervision.[16] These economies are greatly enlarged in the case of cattle which can fend for themselves and can roam freely throughout a large and contiguous area. Hence, one finds two conflicting considerations in deciding on the proper use of land and animals: namely, economies of scale in animal supervision, grazing and land use but diseconomies with respect to the quality of animals.

In principle, animals can be raised under a wide spectrum of institutional arrangements. At one extreme, animals, land, and other resources could be held as private property by their individual owners; at the other extreme, all resources could be held in common by either a community or a corporate structure owned by private shareholders. But clearly, there are important intermediate positions in which some resources could be held privately and others in common. In each conceivable case, there exists a trade-off between economies of scale, on the one hand, and benefits accruing to herds under more intensive supervision, on the other.[17]

Given the constraints identified above, neither extreme solution would appear to be optimal or even attainable. Instead, in what follows we explain the benefits of a particular mix of ownership regimes.[18]

Under normal conditions, private ownership of land provides the right to exclude trespassers, but enforcing such a right can be costly. Indeed, two characteristics of 19th Century American West substantially raised such costs. First, lots of normal size (by historical standards) were too small to permit full exploitation of economies of scale in animal supervision. Second, animal survival depended upon unfettered mobility of the animals during conditions of stress (as a result of drought, storms, blizzards, etc.). Hence, private property, would be a viable alternative only for land lots of very large size.[19] With such large lots, the costs of excluding others were naturally very large.

At the other extreme, however, if land and animals were held in common either (1) by a large community of people or (2) by a corporation (thereby reducing the exclusion costs), the costs of making appropriate decisions and of supervising their implementation (transactions costs) could be extremely large. Since (1) could require the cooperation of not just one village or town, but many, in the absence of a central authority, the transaction costs of this alternative could be extremely high, especially for non-homogeneous migrant populations typical of the American West.

Alternative (2) would have some substantial advantages over (1) in its ability to reduce transactions costs of decision-making and, because of its limited liability characteristic, could also encourage capital investment. Yet, due to information asymmetries between owners and managers on the one hand and managers and employees on the other, the transaction costs inherent in the corporate solution could also be high. Moreover, in view of the low population density and the

dearth of accumulated local savings in the region, even if the principal-agent problems could be resolved, the investors would have to be attracted from distant regions, in the process further raising the transactions costs of dealing with the information asymmetries between owners and managers.

The animals, in turn, could be owned as private property or in common. If held as private property, the incentives for adequate animal supervision would be increased, since any deterioration in herd quality would directly affect the wealth of its owner. With communal ownership, on the other hand, the effects of any individual's efforts in supervision would be largely external to that individual.

The encouragement of group cohesion, a necessary requisite for success in communal enterprise, is another reason for private ownership of animals. In the face of differences among members in their subjective rates of time preference, private ownership of the animals allows different members of the common pool to choose their own differing savings and investment rates via decisions as to when and how much to sell off of their accumulating animal stocks, thereby avoiding the friction and transactions costs that would arise in reaching a collective decision on such matters. At the same time, in an environment where other assets are even more risky and the markets for such assets underdeveloped, the exchangeability of private property rights in animals would encourage saving and investment.

Finally, other resources which deserve special mention are water rights, law enforcement and corrals. In all these cases there would seem to be important economies of scale in their use. In the case of natural water sources, the larger the area, the lower the risk of

failing to find water. For law enforcement, substantial economies of scale can be attained with a single investigative unit and single police force. Similarly, for corrals, due to their only sporadic use, they can be used by multiple users at different times without creating any interference to others.

Given the environmental constraints described above, these considerations lead to the conclusion that it was optimal to combine private ownership of animals with common pooling of land and the other resources mentioned above. The optimal size of the resource pool would be affected by a number of factors, including the degree of economies of scale and the determinants behind transactions costs. In view of the well-known deleterious incentives associated with resource pooling, such pools would not always have to be extremely large.

The Institutional Framework.

Next, we provide a somewhat more detailed characterization of an institutional structure which, by combining private property in animals with common property in several kinds of resources, is capable of minimizing the costs of transactions and production.

To retain private property in animals, all animals had to be branded and all brands registered. Since it was primarily through reproduction that capital could accumulate, animal reproduction had to be properly encouraged and accounted for. Among other things, this required the branding of calves and the timing of roundups to be regulated so as to be neither too early as to endanger the health of the calves, nor too late as to impede correct attribution of their ownership (Osgood, 1929, pp. 133-4).

By pooling hands from several different ranches in properly timed roundups, thousands of cattle could be managed effectively.[20] While pooling land and avoiding restrictive barriers (like fences) allowed economies of scale to be reaped, to mitigate the dangers of breed degradation and contagious diseases, whenever possible, herd owners kept their cattle within their customary grazing grounds.[21] Not all the land had to be owned outright, but somehow had to be protected from outsiders and overseen by insiders. Important means of doing so were (1) to own privately land adjacent to water sources, and then to refuse outsiders access to these sources and participation in the common roundups (Osgood, 1929, pp. 186-188), and (2) to regulate use by insiders by limiting the number of animals each could put on the range.

Despite these felicitous practices, some problems remained. For example, since un-branded animals, typically calves with no known mothers, had no clear owner, disputes over their ownership could arise.[22] Also, with animal intermingling, some cattle owners could free ride on the stud services of bulls owned by others, thereby leading to the undersupply of bulls. In the absence of state-supplied security and with limited animal supervision, the animals were also rather vulnerable to theft.

All these considerations led to the formation of cattle pools and associations[23] which helped realize the economies of scale in land and other resources and resolve the various other problems facing the cattle growers. For example, the pools and associations used income from the sale of mavericks (the animals with no known owners) to pay for the services that they provided (Fletcher, 1960,

pp. 64-5, and Osgood, 1929, pp. 149-50 and 153-4). They tried to solve the undersupply of bulls problem by requiring members to supply them in proportion to the size of their herds (Fletcher, 1960, p. 78).

As mentioned above, the optimal size of the resource pool is determined by the tradeoff between the economies of scale obtained in larger-size plots and the diseconomies of scale deriving from the costs of communicating, coordinating and maintaining group cohesion.[24] While many different factors could in principle affect this tradeoff, we focus on a few of the most important.

One such factor is the kind of animals that are available. Typically, the advantages of larger scale are lower for animals requiring more care and supervision such as sheep and the aforementioned less hardy but higher valued breeds of cattle than for the hardier Longhorns that dominated the American West until well into the 1880s (Dary, 1981, pp. 248-9).

Another factor affecting these tradeoffs is weather and vegetation. Of particular importance in this respect is the distance between reliable water sources and grazing areas. This affects the choices of both the animals to be raised and their breeds.[25] Closely related is the local variability of rainfall and temperature. The greater such variability relative to cost of bringing water and food to the animals, the greater are the economies of scale and hence the advantages of resource pooling.[26] However, either natural barriers, such as mountain ranges or bodies of water, or man-made barriers, such as railroads, walls and fences, to the free movement of animals, would limit the optimal size of the pool.[27]

Similarly, barriers to communication and coordination could raise the transactions costs of pooling arrangements. Among the factors affecting these transactions costs would be the degree of homogeneity of background of those involved in animal husbandry in any particular region, the costs of exit from the group and region, the number and complexity of the decisions to be made by the group of resource poolers.[28]

Greater homogeneity of background would presumably mean lower costs of coordination and hence would raise the optimal size of the pool. Greater ease of exit and higher communication costs, on the other hand, would presumably raise the costs of coordination and hence lower the optimal size of the pool. So, too, would the number and complexity of the decisions to be made, such as the number of animals to be permitted on the range, the number of bulls to be supplied by each member, the number and timing of roundups, the means of sharing group costs, and the nature and magnitude of group activities.

Application of the Model to the American West.

Generally speaking, in groups of large size, one could expect a multi-level and federational structure to minimize transactions costs.[29] Not surprisingly, those activities such as roundups, in which close cooperation was required for success, were accomplished among relatively few ranches at low levels in the organizational structure. On the other hand, those activities in which less frequent communication was required, such as in maintaining detective bureaus, were accomplished by larger numbers of participants at a higher levels in the organizational structure.[30]

The larger associations appointed inspectors at various shipping points to guarantee that cattle taken away from the range could be properly credited to their owners[31] They could also use their market power to bargain with the railroads on freight charges.[32]

In view of the aforementioned potential advantages of corporations, why were economies of scale not exploited by large corporate firms? In fact, as noted below, there were several examples of such exploitation by large Eastern and foreign-owned corporations.[33] Indeed, it was the Earl of Airlie, a foreigner involved in the cattle business, who in 1881 explicitly pointed out the advantages of ranch size on unit costs,[34] and his company, the Prairie Cattle Company, with a foreign capital subscription of 200,000 English pounds, was one of the first such enterprises. Its primary strategy was geographical diversification of its land holdings. The initial results were so successful that the capital subscription was raised to 500,000 English pounds.[35]

Other foreign companies followed suit. The Texas Land and Cattle Company began in 1881 with an authorized capital of 240,000 English pounds and 236,000 acres in Nueces County, but extended its land by purchasing in other parts of Texas and leasing 65,000 acres along the Canadian, Washita and Sweetwater Rivers in the Texas Panhandle. The company's capital was quickly tripled.[36] These foreign syndicates were joined by the Matador Land and Cattle Company, the Hansford Land and Cattle Company, the California Pastoral and Agricultural Company, the Wyoming Cattle Ranch Company, the Western American Cattle Company, the Cattle Ranch and Land Company, the Western Land and Cattle Company, the Maxwell Cattle Company, the Swan

Land and Cattle Company[37] and many, many others.[38]

The extremely large size of the land controlled by these corporations (usually but not always foreign-financed) should be appreciated. For example, the Wyoming Cattle Ranch purchased 2.5 million acres of land and the Swan Company extended for 130 miles from east to west, and up to 100 miles in the north-south direction.[39]

Despite their large size, however, during this period these large corporations cooperated among each other and with other cattlemen through local associations to form pools of even larger size. The Wyoming association had 10 million heads of cattle roaming over 500,000 square miles, and the Texas Live-Stock Association had about 500 members with a combined herd of one million heads.[40]

If land could be bought (or at least controlled) in such large tracts, why didn't the American ranchers on the scene more generally use the corporate organization with or without foreign syndicates? Part of the answer was certainly the poorly developed capital markets on the Western frontier. Since unlike foreigners with access to London financial markets, domestic stock holders could not easily sell off their corporate rights if they were dissatisfied with the way the corporation was run,[41] a better strategy involved the following: (1) to keep ownership over cattle within the framework of a cattle pool or association, (2) to own as little land as possible (but enough to control significant areas of the range), and (3) to move to another location if anything went wrong.

The second and perhaps more fundamental reason was the information asymmetries and their resulting problems between capital owners and local managers and ranch hands. For example, there were

instances where outsiders (including foreigners) were misled concerning the productivity of and even the number of animals belonging to the various enterprises.[42]

While there exists no comprehensive data comparing the relative success of foreign corporations vis-a-vis American ranchers, relatively few foreign companies survived in the industry past the First World War. As a result, one could speculate that relative to foreigners, the American ranchers could better detect the changes that were occurring in the American frontier and adapt more quickly to them. Also, the American ranchers depended less on hired labor, and were less affected by the transactions costs thereof and the pressures of increased labor costs; by doing so, they retained greater incentive to adapt to changing circumstances. For example, after having managed to compete with the foreign corporations by means of their cattle pools and associations, American ranchers seem to have been quicker in the 1890s to realize the rising importance of care and supervision of animals relative to economies of scale.[43]

Empirical Relevance of the Local Variability of Rainfall.

As noted above, one would expect the size and strength of resource pooling institutions to be greater and more enduring in those parts of the American West in which factors tending to raise the importance of economies of scale relative to the advantages of care and supervision were particularly prominent. One such factor noted above was the local variability of rainfall:[44] the larger is such variability, the larger should be the benefits of resource pooling relative to the costs of such pooling and coordination.[45]

As a simple test of the relative importance of this factor, we choose three different Western states in which cattle raising was important at the time and then compare them with respect to the local variability of rainfall on the one hand, and the relative importance of cattle pools and associations on the other. The states chosen are Iowa, Texas (except for the humid Eastern part) and Wyoming, each of which had at least 1 million heads of cattle in 1879.[46]

As a measure of the local variability of rainfall, we use the average correlation of monthly rainfall between all pairs of rainfall stations located 10, 15, 20, 25 and 30 miles apart.[47] Naturally, the correlation coefficients would be expected to decline with the distance between rainfall stations and to do so regardless of the length of the period over which rainfall is measured (hourly, daily, monthly or yearly) (Jackson, 1977).

The average correlation coefficients of monthly rainfall for the years 1936-47 for each designated distance between pairs of meteorological stations, along with the corresponding numbers of such pairs, are presented in Part A of Table 1 for each state. As expected, in each state the size of the correlation coefficients declines with distance. A similar pattern is displayed by the correlation coefficients with daily rainfall in Part B of the table.

More importantly, however, note that for each given approximate distance, the averages of the correlation coefficients are smaller for both Texas and Wyoming than for Iowa. Except for the smallest distances, moreover, interstate differences between Iowa on the one hand and both Texas and Wyoming on the other, are all statistically significant at the 0.01 level. Hence, the rainfall variability factor

would seem to raise the benefits of land pooling in Texas and Wyoming relative to that in Iowa.

As pointed out by Wilson and Thompson (1993), this can be seen explicitly by the fact that, for a situation in which each of the M adjacent plots of equal size in a given region has the same variance of rainfall $\sigma_1^2 = \sigma_2^2 = \sigma_3^2 = \ldots\ldots \sigma_M = \sigma^2$, the average variance for the pooled set of plots σ_ρ^2 is

$$\sigma_\rho^2 = \frac{\sigma^2}{M}\left[1 + (M-1)\rho\right]$$

where ρ is the mean of the rainfall correlations between pairs of adjacent plots. Hence, as long as $\rho < 1$, σ_ρ^2 declines as M rises, and for a given M, σ_ρ^2 declines as ρ falls.

Notably, for Iowa, the state with the lowest local variability of rainfall, we have found no evidence of any cattle pooling activity or of any cattle association during the period under investigation (Bogue, 1959 and Hopkins, 1928) For both states with higher such variability, Texas and Wyoming, however, there is ample evidence of very considerable land pooling and cattle association activity.[48]

In the interest of simplification, the above formulation of the gains arising from land pooling, in a context in which there is substantial local variability of rainfall, assumed that the plots belonging to different holders of land are identical with respect to the variance of yields or rainfall. Nevertheless, this is clearly an unrealistic assumption for the vast majority of areas into which the people brought their animals in the American West.

Indeed, it has been widely recognized that what individual members of the cattle pools did was to purchase land or claim (e.g., under the Homestead Act) land in parcels along the banks of rivers or

lakes (Osgood, 1929, p. 184). This land was sufficiently valuable to justify purchase or settlement costs precisely because of the lower values of σ_N^2 and higher values of production associated with it. It was private ownership of these higher valued pastures which provided the basis for informal claims of the cattle pool on the rights to the adjacent open range. Clearly, since the valuable land privately owned by different members of the pool quite naturally varied by size as well as quality, the sharing of access to such land with other members of the pool provided the others with unequal risk-sharing.

This implies that by contributing plots to the pool with lower values of σ_N^2, some landowning members such as i and j (where $\sigma_{i,T}^2 < \sigma_{l,m}^2$) would be more valuable as a means of risk reduction to other pool members than some others such as l and m. Such differences, therefore, would provide i and j with greater bargaining power vis-a-vis other pool members l and m. Notably, one very common form in which this differential bargaining power materialized was in the convention that each member was allowed to put animals on the common range only in proportion to the quantity of the water-accessible land (near rivers and lakes) that they contributed.

The Decline of the 19th Century Cattle Raising Institutions.

Whereas from the Civil War to the 1890's both formal and informal limited-access common property rights in land dominated the cattle raising industry, due to various technological changes in the 1880's, these arrangements came under increasing stress.

The railroads increased security in the area by making it possible to dispatch quickly troops almost anywhere. Increased security allowed land to come under permanent cultivation. Cheaper

transportation and greater security, in turn, brought more settlers to the region (Fletcher, 1960, pp. 37-8) and made the agricultural lands more valuable. In addition, the railroads transformed the agricultural produce of the region into tradeable commodities that could be sold in distant population centers, and removed the need for open trails for transporting cattle.[49]

The silver boom increased urbanization, incomes and, along with the railroads, the market for beef (especially higher quality beef). This increased the cost of allowing the intermingling of herds in the open range by raising the incentives for improvements in herd quality.[50]

Barbed wire revolutionized fencing technology but raised capital costs.[51] This, together with an understanding that economies of scale were crucial to the economic vitality of the industry, for a time gave corporations an organizational advantage, since they could raise enough capital to build the fences and acquire large tracts of land in fee simple. Barbed wire also increased the relative viability of sheepherding.[52] While fences impeded the grazing ability of cattle in the open range, it failed to do so for sheep since these require constant supervision and hence could be steered through open gates or around fences so as to reach the remaining open range.[53]

Other technological changes which came slightly later contributed to weakening the advantages of cattlemen's associations and corporations. In particular, deep water wells and windmills[54] created new water sources for both animals and crops, and new agricultural techniques made land more productive and made it cheaper to feed stationary cattle. In addition, as state-supplied law and

order spread, the police and inspection services of the associations were less necessary.

All such changes reduced the importance of economies of scale on the open range and pooling arrangements. The improvement of the herds demanded forceful action from individual herd owners, and this could only be accomplished within fenced compounds that were limited in size only by the capital of their owners. While the limited-access open range has never ceased to exist, it is now maintained by the inertia of federal regulations. If it were auctioned off, it would probably find many private buyers.

In retrospect, the Homestead Act can be seen to have had an ambiguous impact on common property institutions. Initially it attracted settlers to the region and allowed the aforementioned land pooling and related institutions to develop; however, as more and more settlers came into the region, higher population densities undermined those same institutions.

The aforementioned efforts to relax the extremely artificial constraints of the Land and Homestead Acts (the Desert Land Act of 1877, the Enlarged Homestead Act of 1909 and the Stock Raising Homestead Act of 1917) represented only very minor modifications in the institutional constraints. As a result, if these constraints were in fact binding, the transition to private property rights in the American West should not have occurred until at least World War I, (when the restrictions on the construction of fences on public land were removed) and probably not until the Taylor Grazing Act of 1934. This act for the first time (1) allowed the still largely federally owned land of the region to be leased under long term contracts in

viably large blocs to private parties, and (2) put a rancher in charge of the Grazing Division of the Department of the Interior, thereby relaxing other regulations constraining the industry.

Yet, as most historians of the period recognize, in fact this transition occurred gradually throughout the West beginning in the late 1880s. By 1900 the open ranges and roundups of the earlier period had yielded throughout the West to private ranches and fences. The explanation presented in this paper is more consistent with these developments than the traditional, legal constraint explanation.

We turn now to additional evidence that common property institutions developed in various places where the Homestead Act did not apply, and also that they re-emerged under the artificially restricted environment of the American Indian Reservations.

Pooling Arrangements in the Absence of Lot Size Restrictions.

Spanish lands in the New World, particularly in the semi-arid regions of Mexico, Texas and California developed institutional arrangements very similar to those of the American West. As pointed out below, however, these had very little to do with restrictions on lot size, and much to do with the need for cooperative arrangements in the presence of economies of scale.

One classic work on these Spanish lands is that of Dusenberry (1963), where the relationship between the Spanish Mesta and the Mexican Mesta is explored. Whereas the former institution was a government-controlled guild of sheep raisers,[55] the latter was an organization designed to bring about the cooperation of stockmen in a semi-arid environment. Dusenberry points out (p. 51) that whereas no land ownership was required for membership in the

Mesta of peninsular Spain, it was required (as of 1574) of members in the Mexican Mesta. "To be a member one had to have at least 3,000 animals of the small type, or at least 1,000 of the large type. Furthermore, he had to own an estancia" (p. 59).

Participation in the Mexican Mesta was thus compulsory for those with sizeable herds; its rules forced participants to bring stray animals to the annual meetings for return to their rightful owners; judges were appointed to settle disputes among stockmen and to enforce regulations; the branding of animals was required and carefully monitored; animals were allowed to intermingle in common lands but rodeos (roundups) were strictly regulated; stock thieves were prosecuted by the central authorities; and publicly financed corrals were constructed. Notably, since limitations on the size of private land holdings in Mexico did not exist, such restrictions could not explain the existence of cooperative arrangements.

Because of (1) their distance from the Spanish and later Mexican capital, (2) their low population density, and (3) increasing immigration from the U.S. and foreign countries, the Northern portions of Spanish territory in North America, namely, the territories which now comprise the states of Texas, New Mexico, Arizona and California became increasingly independent of Spain and later Mexico. Indeed, much of this territory became the Republic of Texas for a decade, before being annexed by the U.S. after the Mexican War in 1846. Notably, under Spanish, Mexican and under the Republic of Texas rule, huge grants of land were made to private individuals and corporations, and the resulting private property in all these territories (and later states) was respected by the U.S.

according to the treaties of annexation.

For example, in the case of Texas, at independence many individuals possessed private holdings of land of at least 10,000 acres and some over a million acres in size. Indeed, at independence every married resident of Texas was guaranteed at least 4,605 acres of land and immigrants often considerably more. As a result, the average sizes of private landholdings in Texas and California were many times as large as those in other states and territories (Dale, 1960, p.5).

One of the more profound influences on the cattle industry and land use was the experience of the Civil War in Texas. Texan males were sent off to defend the Confederacy's eastern front, leaving the cattle stock unattended. The blockade of nearby ports, together with an excess number of animals, reduced the prices of Texan cattle to almost nothing and disrupted the industry's development. However, when the soldiers returned from the war in the mid-1860s, they found that the wild cattle had multiplied without supervision; this experience demonstrated the advantages of the open range system in which cattle would be allowed to roam freely.[56]

Several other conditions of post-Civil War Texas gave a tremendous boost to the cattle industry, to cattle pools and associations, and to the roundups and various other collective activities which they undertook. Among the more important of these were lack of security, instability of weather conditions in the years immediately following the war (Cox, 1895 and Dobie, 1943), and the need to find new outside markets for the greatly expanded herds and to create trails to those markets. Often these trails passed through territory occupied by yet unsubdued Indian tribes, thus adding to the

already severe security problem. At other times they passed through narrow mountain passes, across not easily fordable rivers, or over barriers imposed by local residents opposed to the passage of Texan cattle, thereby posing further challenges to the cowboys.

These challenges were more formidable than elsewhere and could not be successfully met by individual animal owners, implying that collective action in the form of cattle pools and associations was necessary for success. Not surprisingly, these pools and associations started earlier and developed a more comprehensive set of activities in Texas than anywhere else in the West (Clarke, 1976).

Similar conditions, the absence of artificial size ceilings, aridity, rainfall variability, and the absence of law and order, prevailed in California. As a Spanish dependency prior to the Mexican independence in 1821, much of its inhabited territory had been granted by the Spanish authorities to a chain of 21 huge missions and at least 300 ranchos, each about 40,000 acres in size. Mexican independence changed virtually nothing; indeed, under Mexican rule, the Governor made some 500 large grants, subject only to a maximum of 50,000 acres (Robinson, 1948). Quite a few of the Mexican land grants were made after the Secularization Act of 1833, which ended mission rule and ushered in the golden age of the ranchos. Even before secularization, pressure had been building among ranchers in the dry southern half of the region to strip the missions of their land and convert them into a state-owned commons for use by local ranchers (Cleland, 1941). Since fences were not economic, the technology in cattle raising remained that of cooperative land pooling with periodic roundups.

The treaty annexing California to the United States in 1846 required the U.S. to respect the existing laws on property and hence the legitimacy of the ranchos which ranged in size up to 115,000 acres, several of which might well be owned by the same person (Robinson, 1948). Despite the importance of large private landholdings, in 1851 the new state of California passed a law codifying many of the existing institutional features of commons-type cattle ranching, requiring brand registration, advance public notice of the time, location and number of roundups, and a "judge of the plains" to supervise and settle any disagreements at such roundups (Cleland, 1946, Robinson, 1948 and Burcham, 1961). In California, these arrangements remained in force only until the end of the Civil War, when the fragmentation of land (as a result of the arrival of new settlers and their challenge of the Spanish and Mexican land grants) increased the demand for fencing and undermined the rationale for cattle pools.

The experience of some American Indian tribes also shows that despite adverse (but different) legal and federal regulatory constraints, several tribes succeeded in adapting similar institutions well suited to the environments in which they were forced to live.

Most Indian tribes in the West had been by tradition hunting, gathering or agricultural societies, and took up animal husbandry only later as a means of adapting to new circumstances. Many of them were forcibly relocated on isolated reservations in the semi-arid West in the 1880s. As such, their environmental conditions were similar to or even more extreme than those described elsewhere in the West: poor land quality, poorly developed capital markets, poor transportation

networks, the lack of reliable water sources, low population densities, and the absence of law and order. Indeed, most such tribes were surrounded by powerful enemies and their members could not be guaranteed that permanent improvements to their lands--as would be required for agriculture--would be respected.[57]

Their one advantage over the white settlers was their experience with tribal institutions, which could now be adapted to organize a new and very different productive activity on a cooperative basis.[58] Although the imposition by outsiders of ineffective land-tenure structures could destroy their productive capacity, as described below, there is evidence that in these semi-arid environments, tribal institutions could in some cases sustain the land-intensive, labor extensive roundup technology of cattle raising in an effective manner, both before and after 1900.

One successful example is the Western Sioux who had been buffalo hunters before settlement on reservations.[59] Beginning in the 1870s, however, cattle raising caught on and flourished until the Allotment Act (Dawes Act) of 1887 which led to (a) the decimation of reservations in general, (b) considerable alienation of land to white farmers and (c) the undermining of both tribal institutions and the incentives to engage in animal husbandry. Thanks to the arrival of a perceptive reservation administrator in 1900, open range cattle raising with roundups was so successfully re-introduced that by 1914 reservation inhabitants no longer had need for the food rations on which they had been so totally dependent prior to 1900.

Carlson (1981) reported similar success in the same activities by the Blackfeet between 1887 and 1900, since this tribe had enjoyed exemption from the provisions of the Allotment Act. More recent examples of success in this regard are the Pueblos of New Mexico and the Apaches of the San Carlos Reservation in Eastern Arizona,[60] who were using similar techniques between 1930 and 1960. Notably, among the Pueblos, the chief was described as having charge of all range and farm land, allotting the range to different herding associations, limiting the number of animals that could be placed on any particular range, stipulating the dates for dipping of the cattle (for protection against disease-carrying ticks), and also planning and supervising all animal roundups and sales.

In the case of the Apaches, the initiation of the cattle associations and the open range system can again be attributed to the enlightened leadership of a reservation superintendent who, on arrival in 1923, recognized the drawbacks of the existing parcellization of reservation holdings. As a result, cattle associations were encouraged and within a few years were officially sanctioned by the tribe. The tribe became active in the enforcement of the rules and regulations concerning roundups, protection against overgrazing, the assignment and collection of user fees (on a per head basis), quality control and animal sales. By the mid 1940s, the cattle herd had been built up from nothing to about 40,000 head. Since that time the advice of technocrats has been to increase fencing and the number of water holes, thereby underming the cooperative range system in this territory. Notably, despite the major investments in water holes and fencing, by 1960 the herd size had declined to only a little over half

what it had been under the former system.

Another remarkable demonstration of the economic superiority of limited access common property arrangement in semi-arid Indian lands derives from the revocation, in 1889, by the U.S. Congress of a proposed long-term lease of Cherokee land between the Cherokee tribe and an association of non-Indian cattlemen known as the Cherokee Strip Live Stock Association.[61] Prior to its revocation, the Cherokee tribe had been allowed to impose user fees on non-Cherokee ranchers who put their cattle on designated land in Cherokee territory. Indeed, both Cherokee and non-Cherokee ranchers had been successful in their practice of cooperative ranching in this territory. The proposed lease was to give the aforementioned association exclusive rights to put their cattle on a high-quality pasture portion of the territory in return for an annual rent several times that which had been collected from the ranchers in the past.

To the chagrin of the Cherokees, Congress not only annuled the agreement but also required the tribe to sell the land to the government (for redistribution to white settlers) at a price which was only a fraction of the present value of the proposed annual rent. Clearly, even in the late 1880s, the cooperative range system was sufficiently profitable to justify rental fees equivalent in present value terms to several times that offered by agricultural users with private property rights.[62]

Conclusions.

The emergence of cattle grazing in the American West during the 19th Century was paralled by a rather amazing evolution of institutional relationships. This evolution was characterized by the

rise and then subsequent fall of a variety of resource- pooling (especially land-pooling) arrangements with many but not all of the characteristics of common property rights regimes. The conventional explanation for the evolution of these common property institutions hinges on the existence of and later overcoming of the legal obstacles to the efficient transfer of land located in the American West from the federal government into private hands through ownership or long term leases. This paper questions the validity of the conventional explanation and proposes an alternative based on a variety of environmental factors affecting the benefits relative to costs of resource pooling.

This paper demonstrates a number of related propositions: (1) that the alternative explanation fits rather well the detailed characteristics of the pooling arrangements, (2) that the alternative explanation better explains why the timing of the downfall of these pooling arrangements varied from place to place rather than occurring at the same time in the 1920s or 1930s, (3) since one of the important factors in the alternative explanation is the local variability of rainfall, that interstate variations in this factor were positively correlated with interstate variations in the incidence and strength of the pooling institutions, and (4) that the applicability of the alternative theory is by no means limited to the American West of the 19th Century.

TABLE 1

Correlation Coefficients Among Rainfall Measures at Pairs of Meteorological Stations for the Years 1936-47.

	Approximate Distance in Miles Between Stations					
A. MONTHLY	10	15	20	25	30	40
Iowa	.9595 (3)	.9114 (5)	.8866 (13)	.8756 (17)	.8750 (27)	.8754 (36)
Texas	.8257 (6)	.8087 (13)	.7744 (22)	.7457 (19)	.7458 (22)	.7148 (26)
Wyoming	.8594 (8)	--	.7246 (36)	--	.6382 (52)	.5580 (66)
B. DAILY						
Iowa	.6743 (3)	.7573 (5)	.5974 (13)	.5622 (17)	.5376 (27)	.5539 (36)
Texas	.6171 (6)	.4292 (14)	.3876 (22)	.3762 (20)	.4128 (21)	.3411 (28)
Wyoming	.6014 (7)	--	.5426 (34)	--	.4998 (48)	.4148 (56)

Note: Numbers in parentheses represent the number of pairs of rainfall stations for which correlation coefficients were averaged.

Source: Weather Bureau, U.S. Department of Commerce (1936-47). Climatological Data for the United States by Section. Washington, D.C.

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NOTES

[1]See, for example, Barzel (1989).

[2]For example, a modern economic history textbook makes the following claim "The Homestead Act was written with Eastern agricultural conditions in mind; 160 acres of land was an ample size of farm for a family in the East. in the high plains, mountains and deserts of the western regions of the country where arid conditions required a larger amount for a viable farm, the Homestead Act was not well-suited to the needs of farmers and ranchers in these areas. Not surprisingly, they used a variety of ways to get around the restrictions in size of land grants under the Homestead Act" (Paulson, 1981, 195). See also Anderson (1987).

[3]A summary of land disposal restrictions both before and after the Homestead Act can be found in Davis et al (1972, 101-109). For the impact of high prices and restrictions on the use of land, see Dennen (1975), Anderson and Hill (1975, 1983) and Libecap (1981).

[4]The extensive work of Paul Gates (1954, 1968, 1973) and his followers had demonstrated that there were many loopholes in the existing laws, and that fraudulent ways could be found to circumvent the laws.

[5]For an extensive discussion of Texas and California during the Spanish period, see Dary (1981). Land policies in the post-independence history of Texas are discussed by Lang (1932).

[6]See Brand (1961), Briggs (1934), Burcham (1961), Cleland (1941), Dusenberry (1963), Gomez (1985) and Lang (1932).

[7]See Lueck (1992) for an interesting and related discussion of the various types of contracts that may arise with common property arrangements.

[8]See Dobie (1943), Frink, Jackson and Spring (1956), Kincer (1923), McCallum and McCallum (1965) and Rister (1928).

[9]See Osgood (1954, p. 138).

[10]See Billington (1974, p. 589).

[11]"Cattle drifted for miles before a blizzard and if they could keep moving, tails to the wind, they would probably survive. Once they came to a halt before an impassable barrier, they were lost, unless the storm abated" (Osgood, 1929, p. 193).

[12]At the end of the Civil War, there was more cattle in Texas than there had been at the start of the War, even though the cattle had been left alone to fend for itself (Dobie, 1943, p. 103).

[13]A more detailed discussion of these issues can be found in Osgood (1929, pp. 137-8).

[14]See McCoy (1940, pp. 215-43).

[15]See Demsetz (1967) and Eggertsson (1991).

[16]This arises from indivisibilities. For example, with respect to sheep, with the help of one or more dogs, a single shepherd can care for anywhere from one to 5,000 sheep.

[17]See Lueck (1992, pp. 9-10).

[18]In some respects, e.g. the emphasis on the trade off between different types of transaction costs, our argument is similar to those of Field (1989) and Lueck (1992). Nevertheless, in contrast to their models, our explanation features economies of scale and risk reduction.

[19]See Osgood (1929, p 193).

[20]The roundup is described in some detail by Fletcher (1960, pp.94-100) and Dary (1981, pp. 158-167).

[21]See Dobie (1943, p. 143), Dale (1960, p. 83) and Billington (1974, p. 592).

[22]"A law against stock stealing, properly enforced, and an adequate estray law gave [a settler in an agricultural frontier] all the legal protection he needed. For the range cattleman, this was not sufficient. His stock, together with thousands of heads belonging to other owners, were scattered over hundreds of square miles of territory" (Osgood, 1929, p.127).

[23]Cattle pools and associations are discussed especially well by Pelzer (1936, pp. 73-115) and Peake (1937, pp. 103-68).

[24]The problems of reaching decisions by the Eastern Montana Stockgrowers Association is discussed by Fletcher (1960, p. 75).

[25]It was early recognized that eastern cattle were less able to stand the rigors of winters in the Great Plains (Osgood, 1929, pp. 93-4).

[26] This is a much underappreciated characteristic of weather conditions in arid and semi-arid regions such as the American West. See Wilson and Thompson (1992) and Nugent and Sanchez (forthcoming).

[27]See Oliphant (1968).

[28]See Hirschman (1970) and Olson (1965).

[29]See Hardin (1982) and Olson (1965).

[30]Fletcher (1960, pp. 58-61 and 74-75) mentions the process of organizing local associations and joining them to a parent group, and also the merging of two larger organizations. Dale (1960, p. 85) also has a brief discussion of this issue.

[31]See Osgood (1929, pp. 151-2) and Rister (1928, pp.

[32]See Peake (1937).

[33]Osgood (1929, pp.97-104) provides a good summary of outside capital in the region.

[34]See Frink, Jackson and Spring (1946, p. 246).

[35]See Frink, Jackson and Spring (1956, p. 145)

[36]See Frink, Jackson and Spring (1956, pp. 148-9).

[37]For a detailed history of this company, see Mothershead (1971).

[38]Although Frink, Jackson and Spring (1956) has the most detailed history of these companies, the reader can also refer to Pelzer (1936).

[39]See Frink, Jackson and Spring (1956, p. 167).

[40]See Frink, Jackson and Spring (1956, p. 227).

[41]There was even an attempt to form a corporate trust on a national basis to internalize some of the externalities that are mentioned in this paper. See Gressley (1961).

[42]"Padded figures were the rule of the day, and the book count [of animals] customarily accepted by British and Scotch companies was apt to be far in excess of actual count" (Fletcher, 1960, p. 54).

[43]The liquidation or reorganization of British companies is discussed at length by Frink, Jackson and Spring (1956, pp. 270-97).

[44]The local variability of rainfall in the Great Plains is discussed by Monteverdi (1978), Oladipo (1986) and Rosenberg (1987).

[45]It should be emphasized that some of these pools were of immense size (Dale, 1960), fencing off hundreds of thousands of acres. Also, The Wyoming Stockgrowers Association, the most powerful of all groups, was able to control the whole state of Wyoming (Dale, 1960, p. 86).

[46]According to the 1880 U. S. Census of Agriculture.

[47]The data was gathered from Weather Bureau, U. S. Department of Commerce (1936-47).

[48]For Texas, see Cox (1895) and for Wyoming, see Larson (1965). Notably, these activities started earlier and lasted longer in these states than in most other states of the American West.

[49]See Libecap (1981) and Dennen (1976).

[50]The transition toward higher quality beef throughout the period under consideration is discussed by Dale (1960, pp. 147-58).

[51]See McCallum and McCallum (1965).

[52]The switch from cattle to sheep is discussed in Dale 98-9).

[53]A personal story of sheep-herding in 19th century America can be read in Maudslay (1951).

[54]See Baker (1989) and Dale (1960, p. 110).

[55]A new interpretation of the Spanish Mesta has been provided by Nugent and Sanchez (1989).

[56]See Dary (1981) for a discussion of conditions during the Civil War and after.

[57]Fletcher (1960, p. 41) discusses the problems faced by the Indians.

[58]For a discussion on the role of tribal institutions in semi-arid environments, see Nugent and Sanchez (forthcoming). The failure to understand the role of tribal chiefs, tribal councils, and cooperative institutional arrangements has frequently led to the introduction of private property rights in technological and environmental conditions for which these rights are not optimal.

[59]This sections draws on the work of Carlson (1981).

[60]See Brophy and Aberle (1966) and Getty (1961-62).

[61]See Savage (1973).

[62] It should be noted, however, that not all common property arrangements in Indian lands have been successful. Libecap and Johnson (1980) have studied the case of the Navajos and have reached a negative evaluation of such arrangements. However, several features of the Navajo situation were rather special and hence reduce that study's relevance to the present analysis.